

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,928,565 B2  
APPLICATION NO. : 09/834846  
DATED : August 9, 2005  
INVENTOR(S) : Watts, Jr. et al.

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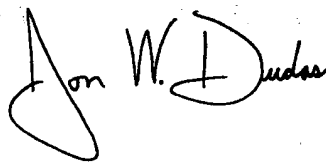
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

The title page showing the illustrative figure should be deleted to be replaced with the attached title page.

The drawing sheets, 1-5 consisting of Figs. 1-9, should be deleted to be replaced with drawing sheets, consisting of Figs. 1-9, as shown on the attached page.

Signed and Sealed this

Thirteenth Day of March, 2007

A handwritten signature in black ink, reading "Jon W. Dudas". The signature is stylized, with a large, looped initial "J" and a distinct "D" at the end.

JON W. DUDAS  
*Director of the United States Patent and Trademark Office*

(12) **United States Patent**  
Watts, Jr. et al.

(10) Patent No.: **US 6,928,565 B2**  
(45) Date of Patent: **Aug. 9, 2005**

(54) **COMPUTER SYSTEM THERMAL LAP  
MANAGEMENT METHOD AND APPARATUS**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 736 days.

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(22) Filed: Apr. 13, 2001

(65) Prior Publication Data

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(51) Int. Cl.<sup>7</sup> ..... G06F 1/20; G06F 1/28

(52) U.S. Cl. .... 713/322; 713/300; 361/687;  
361/695; 374/102

(58) Field of Search ..... 713/300, 322,  
713/323, 324, 340; 361/93.8, 103, 124,  
161, 676, 687, 695; 374/100, 101, 102,  
178; 702/63, 99, 130, 132, 136

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Primary Examiner—Thuan Du

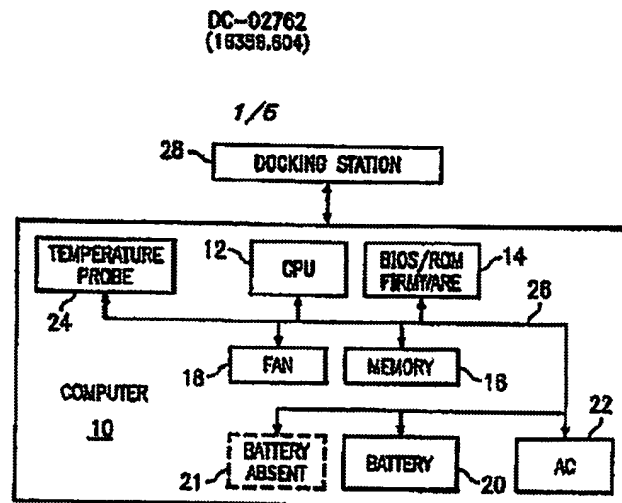
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(57) **ABSTRACT**

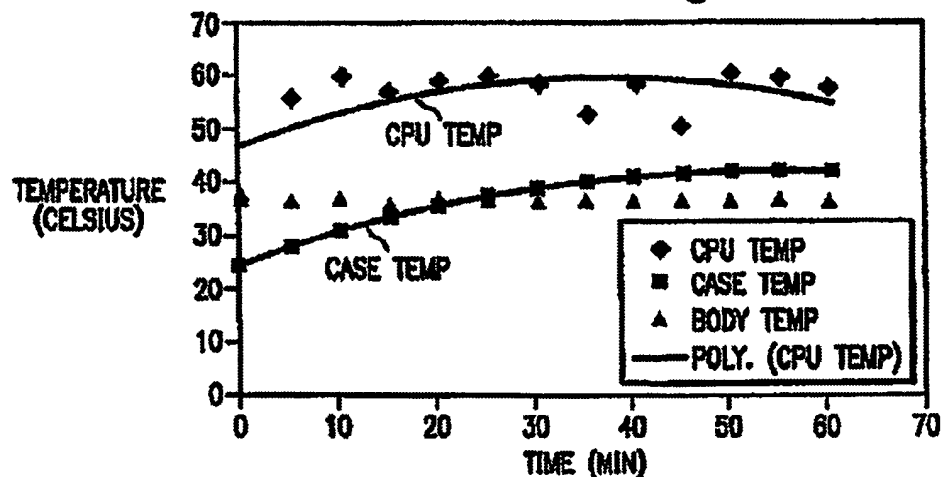
A computer comprises a central processing unit, at least one fan disposed for providing cooling to the at least one central processing unit, and a thermal manager. The thermal manager monitors a temperature of the central processing unit and dynamically controls a throttling of the central processing unit and the at least one fan according to a thermal management algorithm.

33 Claims, 9 Drawing Sheets

*Fig. 1*







COOL LAP 7b	SMART CPU	HDD TIMER	MONITOR TIMER	SYSTEM TIMER	ACPI	AMBIENT	SURFACE TEMP
ON	ON	OFF	OFF	OFF	ON	23.1	24.4

TIME (MINUTES)	0	5	10	15	20	25	30
CPU TEMP	32	48	47	48	49	49	50
CPU TEMP IN F	89.6	118.4	116.6	118.4	120.2	120.2	122
CASE TEMP	26.5	30	32.2	33.7	34.5	35.2	35.8
CASE TEMP IN F	79.7	86	89.96	92.66	94.1	95.36	96.44
CPU SPEED	693	694	604	604	605	602	604
APPLICATION	EXCITE EXTREME 3D FASHION SHOW						

TIME (MINUTES)	35	40	45	50	55	60
CPU TEMP	49	49	50	50	50	50
CPU TEMP IN F	120.2	120.2	122	122	122	122
CASE TEMP	36.2	36.5	36.8	37	37.3	37.5
CASE TEMP IN F	97.16	97.7	98.24	98.6	99.14	99.5
CPU SPEED	604	603	608	604	604	604
APPLICATION	EXCITE EXTREME 3D FASHION SHOW					

Fig. 5

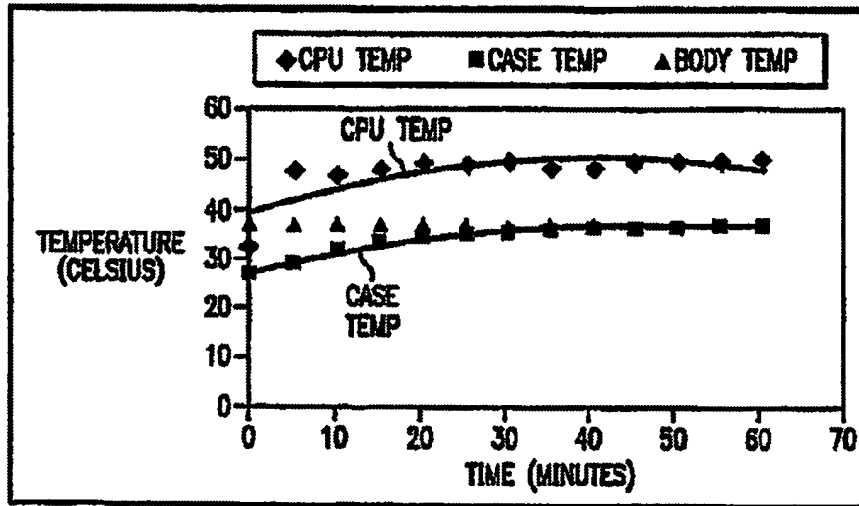
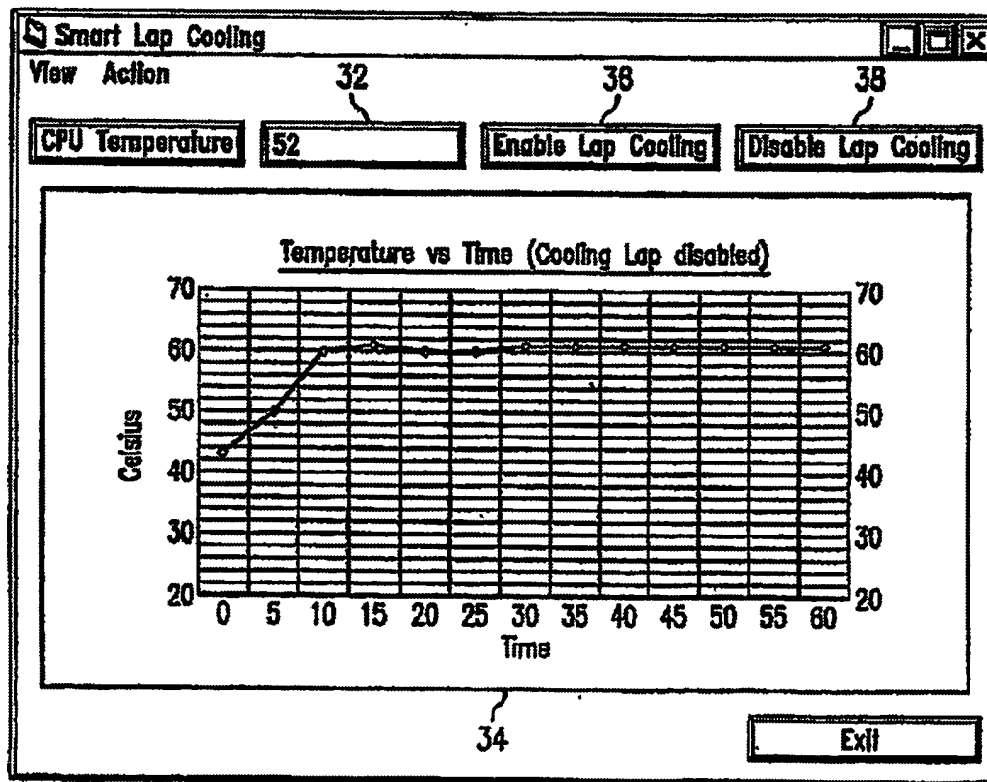
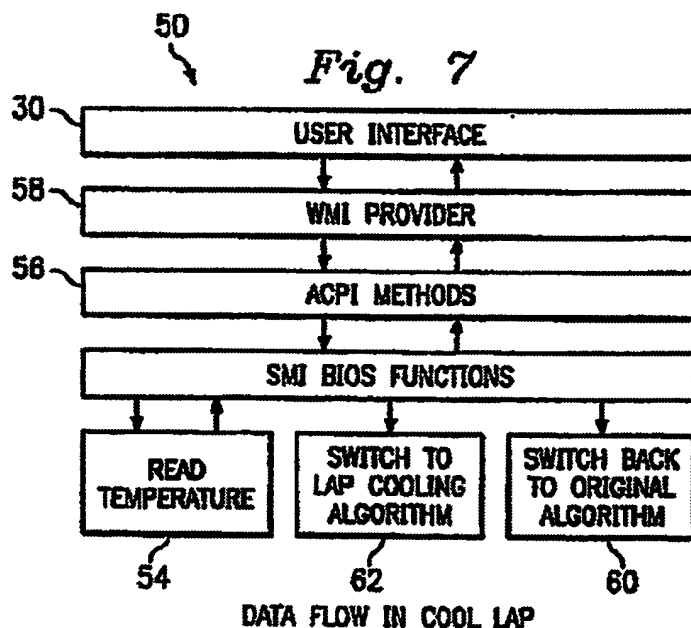


Fig. 6



*Fig. 8*

LOWER RANGE	VALUE	HIGHER RANGE	VALUE	ACTION
TEMP_ABS_LOW:	-128	RANGE_1_HI:	23	No Action
RANGE_1_LO:	20	RANGE_2_HI:	25	No Action
RANGE_2_LO:	22	RANGE_3_HI:	26	TH1, Fan1 Low
RANGE_3_LO:	23	RANGE_4_HI:	27	TH1, Fan1 HI
RANGE_4_LO:	24	RANGE_5_HI:	55	TH1, Fan1 HI, Fan2 Low
RANGE_5_LO:	47	RANGE_6_HI:	65	TH2, Fan1 HI, Fan2 HI
RANGE_6_LO:	58	RANGE_7_HI:	90	TH3, Fan1 HI, Fan2 HI
RANGE_7_LO:	55	TEMP_CRITICAL-1:	101	TH4, Fan1 HI, Fan2 HI
RANGE_8_LO:	90	TEMP_CRITICAL:	102	TH4, Fan1 HI, Fan2 HI, ACPI NOTIFY
				SwOff (Power off the unit)

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*Fig. 9*

LOWER RANGE	VALUE	HIGHER RANGE	VALUE	ACTION
TEMP_ABS_LOW:	-128	RANGE_1_HI:	23	No Action
RANGE_1_LO:	20	RANGE_2_HI:	25	No Action
RANGE_2_LO:	22	RANGE_3_HI:	26	TH1, Fan1 Low
RANGE_3_LO:	23	RANGE_4_HI:	27	TH1, Fan1 Hi
RANGE_4_LO:	24	RANGE_5_HI:	50	TH1, Fan1 Hi, Fan2 Low
RANGE_5_LO:	42	RANGE_6_HI:	60	TH2, Fan1 Hi, Fan2 Hi
RANGE_6_LO:	53	RANGE_7_HI:	75	TH3, Fan1 Hi, Fan2 Hi
RANGE_7_LO:	60	TEMP_CRITICAL-1:	101	TH4, Fan1 Hi, Fan2 Hi
RANGE_8_LO:	90	TEMP_CRITICAL:	102	TH4, Fan1 Hi, Fan2 Hi, ACPINOTIFY
				SwOff (Power off the unit)